AbstractID: 5453 Title: Implementing a Parallel Monte Carlo System as a Clinical Treatment Planning System Validation Tool


**Purpose:** We present the implementation of an automated EGSnrc-based Monte Carlo (MC) system within a parallel computing environment as a tool for validating the dose distributions produced by a clinical treatment planning system (TPS) for external beam radiotherapy.

**Method and Materials:** A clinical plan is generated on Varian's Eclipse TPS, which produces a set of DICOM RT data objects: RT Plan, RT Structure Set, RT Dose and a CT image set. MC simulation parameters are read and calculated from the DICOM RT objects. The CT image set is then used to generate a virtual phantom in a manner analogous to that of CTcreate (the relevant EGSnrc program), but with the added advantage of incorporating the structures in RT Structure Set for volume definition within the phantom. The MC simulation is broken into stages that progress from the target in the head of the accelerator (modeled explicitly), through the various stages of collimation, and into the phantom using both BEAMnrc and DOSXYZnrc on a dedicated cluster of 18 processors. Using RT Dose, we compare absolute dose differences between the TPS and MC quantitatively in 3D using a $\chi$ metric. To illustrate the implementation, we compare dose distributions for an unblocked four field pelvis plan at 15 MV.

**Results:** Simulation of the complete plan took < 7 hours, achieving statistical uncertainties of ~1.6% for each field (at isocenter) in $2.5 \times 2.5 \times 3$ mm$^3$ voxels. Within the body contour 98.4% of the MC dose voxels agree with the TPS (2%/2.5 mm criteria). Significant differences (> 4%) are observed around the bony anatomy.

**Conclusion:** This work establishes a framework for the full clinical implementation of MC as a tool for TPS verification.